El Niño Winners and Losers Declared

Score another big win for machines over man in the El Niño prediction game. Last spring human forecasters thought they saw signs of an imminent warming of the tropical Pacific, a classic El Niño, that could wreak havoc with weather around the globe. Researchers running computer models, on the other hand, saw a slight warming but not enough for an El Niño (*Science*, 27 April 1990, p. 445). The modelers were right.

The season for El Niños has ended and "nothing happened," says Mark Cane of Columbia University's Lamont-Doherty Geological Observatory who, with colleague Stephen Zebiak, runs one of the successful models. Indeed, since the models came online about 5 years ago, there have been two contests to predict El Niños, which occur every 3 to 7 years, and the models have won both. "They are regarded as a success," says the country's official El Niño watcher, Vernon Kousky of the National Weather Service's Climate Analysis Center (CAC) in Camp Springs, Maryland. "The models are still experimental," he says, "but the general feeling is that they're indicating the right trends."

The prospect of having reliable El Niño prediction models is good news beyond the small coterie of tropical Pacific specialists. Worldwide weather patterns are closely tied to El Niño cycles. Robert Livezey, a CAC meteorologist who must make 90-day forecasts of trends in U.S. weather, is just one of those anxious for a way to make better forecasts. Before he and his colleagues could make a prediction last November, they had to decide whether an El Niño was on the way. They chose to believe the human predictors. "All the smart money at that time said [a warming] was coming," he says. "That assumption was the cornerstone of our prediction."

Indeed, Livezey and his CAC colleagues predicted the United States would have a classic El Niño–induced weather pattern with a colder than normal winter in the East and a warmer than normal winter in the West. But almost the opposite conditions prevailed. "We're licking our wounds," he says.

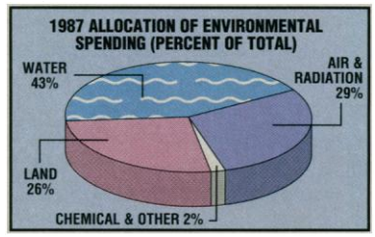
Modeler Tim P. Barnett of Scripps Institution of Oceanography thinks he sees a better way of predicting El Niños. Human forecasters got burned this time, he says, because they let themselves be blown hither and yon by each wind shift or hint of warming in the tropical Pacific. The problem is that most of those changes are meaningless. Barnett's model uses statistical techniques to pick out from that background of climatic noise the long-term trends that reliably signal an El Niño.

Cane and Zebiak, the Lamont-Doherty climate modelers, took yet a different approach, simulating the winds and currents of the tropical Pacific. Although theirs is a highly simplified model, it predicted the 1986–87 El Niño, as well as El Niño's failure to appear in 1990–91. Many researchers now believe that the model has all the features essential to prediction. One of them is the ability to determine when the climate "gun" is loaded—that is, when enough heat has accumulated in the tropical ocean to fuel an El Niño. If the gun isn't loaded, it won't fire, notes Cane, no matter how many disturbances in the ocean-atmosphere system might try to trigger it.

Early last year Cane and Zebiak's model indicated that the Pacific's El Niño gun wasn't loaded yet, but it seems to be now. An electronic mail message the researchers sent out at the end of February told of an "unequivocal" model prediction of a moderate warming sometime in 1991. Cane and Zebiak have particular confidence in this forecast because the model has consistently called for a 1991 El Niño since the summer of 1989. Barnett's statistical model also suggests significant warming by summer, although with only moderate confidence. Together these computer models have laid down the gauntlet. Any humans care to put their money down? ■ RICHARD A. KERR

Costs of a Clean Environment

The United States spent $115 billion in current dollars to clean up pollution in 1990. That's about 40% of the defense budget and just over 2% of the gross national product. And if a new Environmental Protection Agency (EPA) report* is correct, by the year 2000 the total will climb to $171 billion to $185 billion, equal to about 60% of the defense budget and 2.6% to 2.8% of GNP.



"The total is eye-catching. It's a real big number," says Paul Portney, an environmental economist and vice president of Resources for the Future, a Washington think tank. Portney adds that, with a few minor exceptions, EPA's estimates, the first to attempt to put a price tag on the total cost to the nation of complying with all environmental regulations, "are square with everything I have seen." But, he adds, they're contrary to popular belief: "Many people still think that [pollution control] is a small, underfunded thing."

The cause of this misperception, Portney says, is that environmental spending is just not as readily apparent as, say, defense spending, which comes directly out of the Treasury. Indeed, EPA's direct expenditures, about $5.5 billion in 1990, are a pittance of the total cost, most of which is borne by private companies and consumers. And because the cost is in a sense hidden, says Portney, it does not receive the scrutiny given to the big-ticket items like health, defense, and transportation. Portney, for one, thinks it should. "We should see the same public debate on environmental expenditures that we see on defense spending," he says.

EPA apparently agrees and wins plaudits from Portney, who says the agency "deserves a hell of a lot of credit" for publishing the report. "The easiest tack for the agency would be to lie low and not call attention to the [total cost]." That, however, would be contrary to EPA administrator William K. Reilly's ongoing efforts to foster a national debate on environmental policy—specifically, on how to target the nation's resources toward those problems that pose the worst environmental risks (*Science*, 10 August 1990, p. 616). This new report provides further impetus for just such a debate.

To come up with the new cost estimates, EPA analysts relied heavily on historical data of actual environmental spending by the private sector and other government agencies for 1972 to 1987, published each year by the Commerce Department. They also used EPA's data on its past expenditures and projections for new and proposed regulations to extrapolate costs to the year 2000. The estimates include the costs of complying with all EPA regulations, and some state and local requirements, but do not include the costs of wildlife conservation and other environmental programs that don't address pollution control. ■ LESLIE ROBERTS

* *Environmental Investments: The Costs of a Clean Environment.*